Apparatus for High-Temperature Fluid Mixture (p–ρ–T–x) Measurements Based on a Single-Sinker Densimeter

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We describe a new instrument for high-temperature, high pressure, fluid mixture (p–ρ–T–x) measurements. The overall design is similar to other single-sinker, magnetic suspension densimeters, but it incorporates several unique features that allow operation at temperatures up to 773 K with pressures up to 50 MPa. Due to the wide operating range the measuring cell is fabricated from a high-strength, corrosion-resistant, but slightly magnetic, nickel-molybdenum-chromium alloy; this results in a very large force transmission error for the magnetic suspension coupling compared to standard magnetic suspension couplings. The density uncertainty of 0.03 % (k = 2) is dominated by terms arising from the force transmission error. The measuring cell is contained within a vacuum furnace that provides temperature stability and uncertainties on the order of 0.02 K. The pressure uncertainty is (52×10–6·p + 2.0 kPa). First results from this instrument are presented for N2/H2O and CO2/H2O mixtures. The experimental mixtures were prepared gravimetrically with a novel in situ method. The (p–ρ–T–x) behavior was measured for two compositions for each mixture at T = 500 K – 620 K at pressures up to 25 MPa. The data were used to calculate cross second virial coefficients for the gas-water pairs, and these results are compared to recent theoretical values.